On the Oceanographical Observation of the 6th Japanese Antarctic Research Expedition (1961–1962)

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第6次南極観測における海洋の諸問題

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要　旨

第6次南極観測におけるケープタウン，氷海間の海洋観測の結果次のような事実が認められた．

1．表面観測によると，往航時には多くの場合認められている STC の急激な変化が認められたが，帰航時には著しい変化を示さず，往航時とかなり異なった様子を示した．水温の変化はあまり急激ではなく，phosphate-P は南緯 50 度あたりでほとんど認められなくなり，珪素はむしろかなり低緯度の方まで認められた．これは今回の氷状の悪かったことと関係するものと思われる．

第1号氷山，および最終確認氷山は往復とも南緯 50 度内外で認められた．このときの水温は 2 度内外であった．

2．プリンスオラフ沖，パックアイスにそって東経 33 度より 49 度にわたりほぼ東西に行なった数点の各層観測などから推定される水の動きは 50 m, 100 m, 150 m, 200 m の等温線から次のように考えられる．

表面から 50 m 位の浅い部分では，クック沖がやや温かく，ここに東から冷たい水が流れこんでいる．これは氷の移動と大体一致する．

しかし 100 m よりも深いところではむしろ温かい水が東から西へ流れているようである．

クック沖東経 33 度線に沿っておよそ 60 マイル間隔で南北に行なったドレッジの結果によると，南から北に行くに従って礫の数が少なくなり，底質の粒が小さくなるようであった．また南緯 65°49′ 東経 49°03′ 付近のドレッジの結果得られた 2500 m の底質中には礫が多く，これは氷山による運搬を示すものと考えられる．

3．表面が氷で覆われた地域での各層観測の結果から，氷の下の海水はオープンシーの場合と異なることが認められた．氷に覆われた地域では表面から 100m 位まで −1.8°C で同じであり，100m 付近から急激に水温の変化がある．これに反してオープンシーの場合には表面から次第に低温になり，ついで温度が上昇してから再び下降し一定温度になる．海水の酸素含有量も氷の直下ではオープンシーの場合よりも低い値を示している．深い所ではっきりとした差はない．

4．ケープタウン南方の南緯 41.5 度付近は，往航時窒素含量の急激に増加したところであるが，帰航時ここで行なった各層観測の結果によると，水温の変化は複雑で，nitrate-N, nitrite-N もかなり多く検出された．この地域では水塊の不連続があると考えられる．

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1. Introduction

The 6 th Japanese Antarctic Research Expedition ship, the "SOYA", left Tokyo on the 30 th of October 1961 and returned on the 17 th of April 1962. Along the course to and from Antarctica, the amount of dissolved gases and nutrient matter in the sea water were observed. Sampling of the surface water was made daily at 9 : 30 local time during the cruise. And the determinations of temperature, dissolved oxygen, phosphate-P, silicate-Si, ammonia-N, nitrite-N, and nitrate-N were made on board. Samples of the sea water were stored in the pyrex bottle and the polyethylene bottle. Polyethylene bottles of 5 litres and 20 litres were used for the purpose of storing sampls studyed trace elements such as U, Ra, and B etc. Some of them were stored adding 5 *ml* of concentrated nitric acid or filtering with No. 4. G. glass filter.

Bathythermograph observation was made once a day together with collecting the sample. Vertical observations (10 stations) were made also.

In this report, the authors represent the results which were obtained between Cape Town and Antarctica.

2. Method of analysis or observations

Temperature measurement: Canvas bucket was used for the collection of the surface sea water and temperature was measured by ordinary method. A portion of the sea water was applied to chemical analysis.

Bathythermograph observation: Conventional method was used.

pH: TOA DENPA pH meter.

Standard solution: phosphate buffer pH 6.86.

Chlorinity: After returning to Japan, Fajans-Miyake's method was used.

Determination was made by S. MURATA.

Dissolved oxygen: Winkler's method (titration).

Phosphate-P: Denige's method (colorimetry).

Silicate-Si: Silicomolybdic acid method (colorimetry).

Nitrite-N: Griess-Romijn method (colorimetry).

Nitrate-N: Strychnine method (colorimetry).

As a reference conductivity of the sea water was measured with portable conductometer.

3. Results of BT observation

The results of bathythermograph observation were represented in Appendix 1. The curve of the plotted data was omitted in this report.

4. Results of surface observation

The results of surface observation were represented in Appendices 4 and 5 with weather conditions. The variation of temperature, pH, dissolved oxygen and other

nutrient matters were depicted in Figs. 1 and 2.

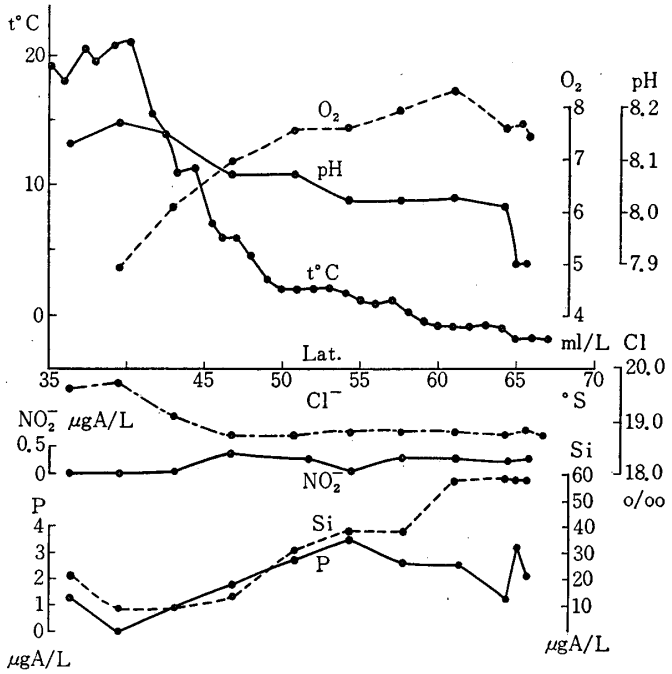


Fig. 1. Variation of surface water components from Cape Town to Antarctica.

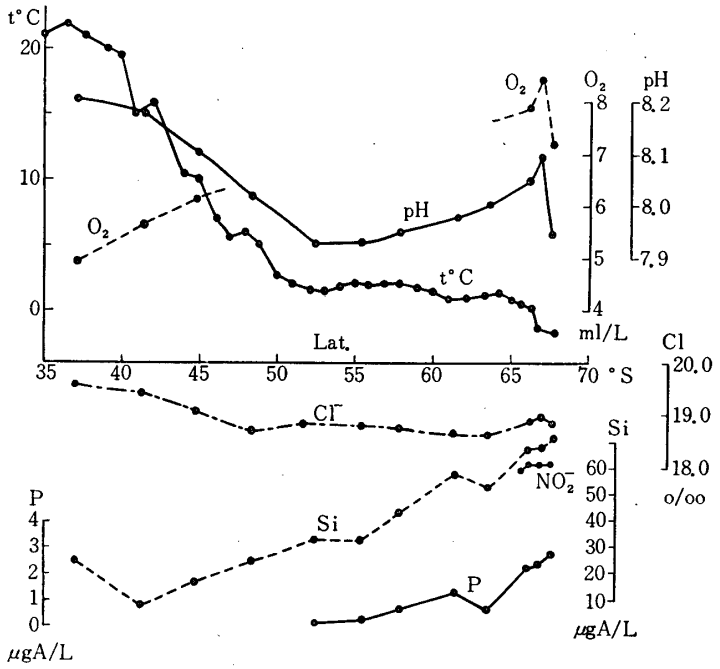


Fig. 2. Variation of surface water components from Antarctica to Cape Town.

Fig. 1 shows the distribution of surface temperature, pH, dissolved oxygen, chlorinity, phosphate-P, silicate-Si and nitrite-N of the sea water between the Cape of Good Hope and Antarctica. And Fig. 2 shows the distribution of these components on the return cruise.

The surface water temperature decreases to 10°C at 41°S and to 6°C at 45°S, and

to 2°C at 50°S. And the coldest water layer, with temperature ranging from 0°C to −1.8°C was extended to the south of 58°S.

As shown in Fig. 1 a sharp change of water temperature at the surface occurrs 40°~43°S where the water temperature goes down from 20°C to 10°C. Thus it may be considered as Agulhas Convergence Region. And Subtropical Convergence Region may be supposed about 45°S where the water temperature goes down from 12°C to 6°C, while Antarctic Convergence may be considered to locate near 48°S where the surface water temperature 2°C was observed.

On the return cruise somewhat different distribution was observed.

The values of pH indicate 8.15 at 41°S and 7.9 from 65°S to the edge of the ice sea. On the return cruise variation of pH value shows a different type.

The distribution of chlorinity shows the same variation as the temperature. Reduction in the chlorinity from 19.76‰ to 18.74‰ was observed between 40°S~45°S. And in areas south of 47°S there was less saline water.

The content of oxygen is 6.08 *ml*/L near 43°S: it increased to 7.54 *ml*/L at 51°S. And it increased to 8.30 at 61°S. But it decreased more or less in the far south region. On the return cruise, we did not determine oxygen because of the storm.

As to the content of silicate-Si in the surface layer, 10 μg atoms/L was observed near 45°S, but it increased 30 μg atoms/L at the Antarctic Convergence. The silicate-Si content increased as the observation station approached to the continent and finally indicated 60 μg atoms/L. On the return cruise the change at the Antarctic Convergence is not so clear as before.

As to the phosphate-P, 1.0 μg atoms/L was observed at 43°S and the content increased gradually as the station approached the ice edge. Then 3.6 μg atoms/L was observed at 55°S. On the return cruise we could not detect phosphate-P at 52°S.

The differences of nutrient matter distribution in outward and returning cruise may be considered that it was partly because of the bad ice condition in this expedition.

5. Results of vertical observations

The results of vertical observation are represented in Appendix 3. Some places where vertical observations had been carried out in Antarctica, are depicted in Fig. 3. The details of the observation are summarized in Appendix 2 and the data was shown in Figs. 4–12.

As to the surface water, the value of pH was below 8.0 and the chlorinity was low as 18.89‰, while in Antarctic circumpolar water, pH exceeds 8.0 and chlorinity attains the constant value of about 19.20‰ down to 2000 m at the several stations.

The lower chlorinity found near the surface might result from the melting of ice.

The amount of dissolved oxygen was about 7 *ml*/L in the surface water, but it decreased to 4 *ml*/L in Antarctic circumpolar water.

Concerning phosphate, the contents in the surface water were 2–3 μg atoms/L

and a few changes were observed in the vertical direction.

Silicate-Si in the surface water was more than 60 μg atoms/L and increased with the depth. Finally it indicated 100 μg atoms/L down to 2000 m.

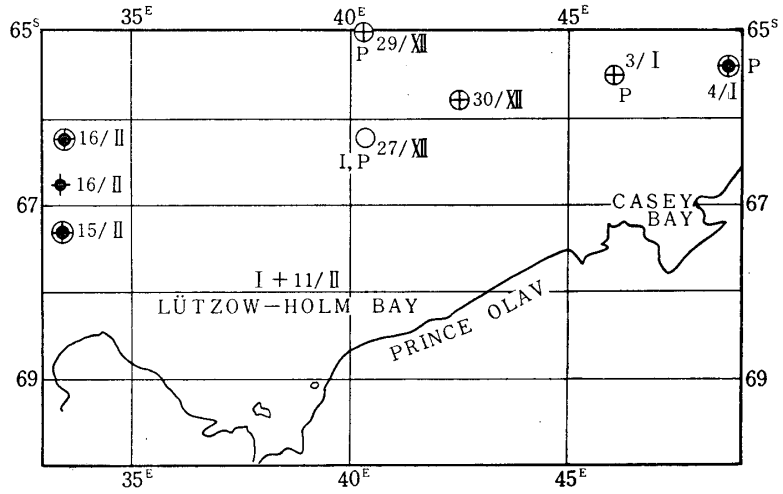


Fig. 3. Stations: vertical observation carried out.

○: vertical observation ●: dredging I: ice sample
+: water sample (20 l) p: plankton 16/II: 16, Feb.

Station No. 1 showed a somewhat different type of distribution because of locating in the pack ice region.

The distribution of temperature and the movements of sea water at the depth of 50 m, 100 m, 150 m, and 200 m were depicted in Figs. 13, 14, 15 and 16. Above the data the movements of sea water near Lützow-Holm Bay were suggested as follows: In the shallow layer cold water may be moving from east to west, while in the deep layer cold water may be moving in the opposite direction.

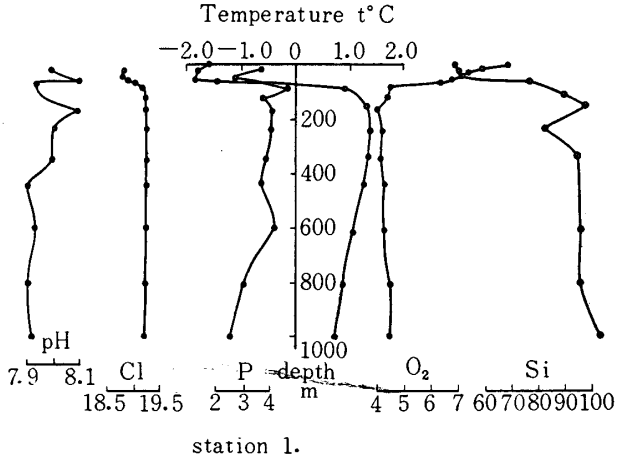
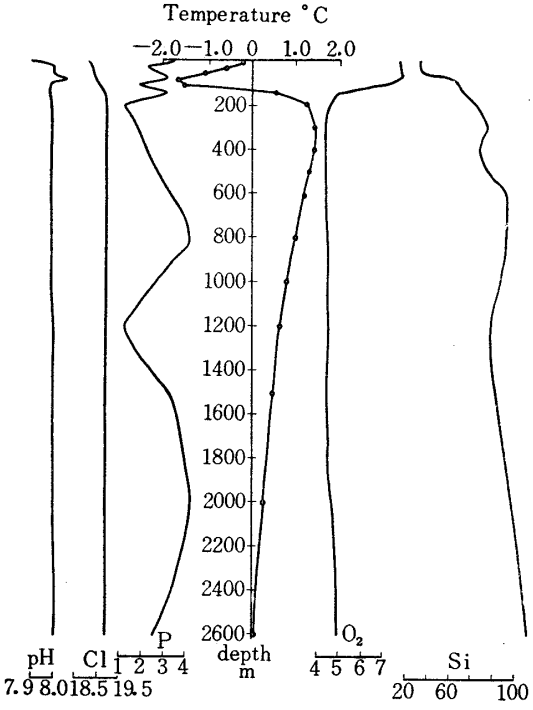
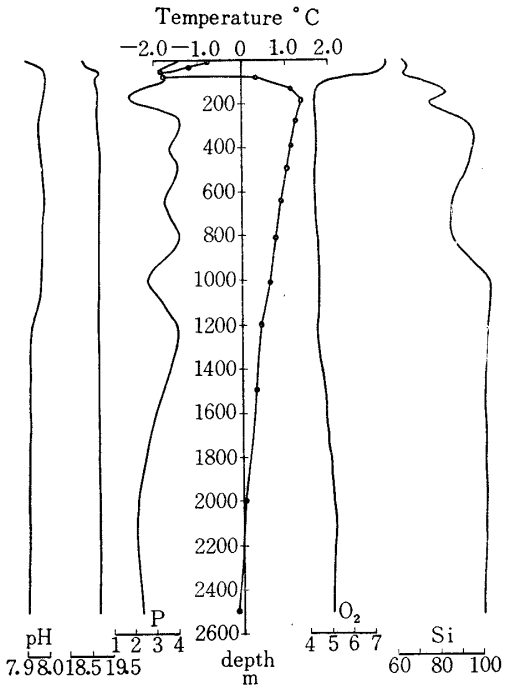


Fig. 4. Results of vertical observation. 27-XII-1961 66°18′S, 40°20′E



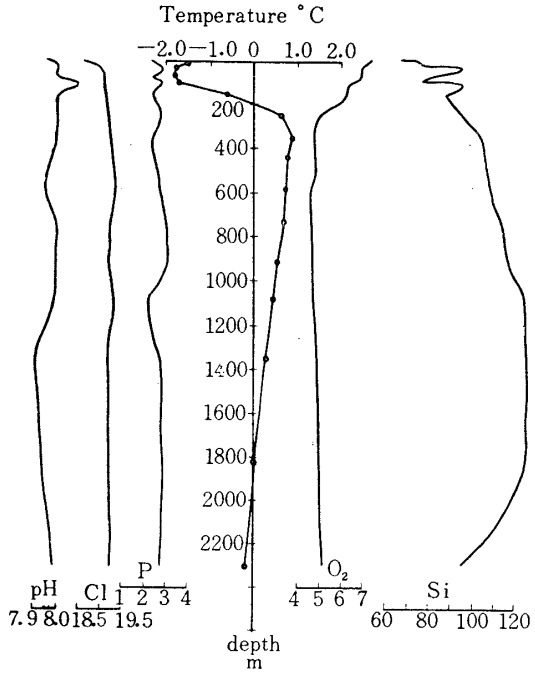
Station 2

Fig. 5. Results of vertical observation.
29-XII-1961 65°00′S, 40°19.5′E



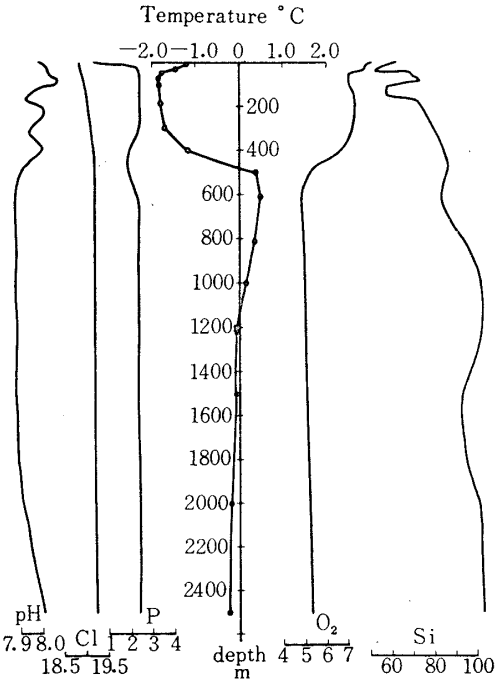
Station 3

Fig. 6. Results of vertical observation.
30-XII-1961 65°43′S, 42°53.5′E



Station 4

Fig. 7. Results of vertical observation.
3-I-1962 65°-26′S, 46°00′E



Station 5

Fig. 8. Results of vertical observation.
4-I-1962 65°48.8′S, 49°02.8′E

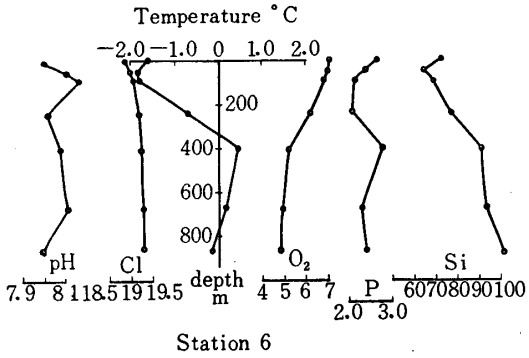


Fig. 9. Results of vertical observation.
15-II-1962 67°33′S, 33°35′E

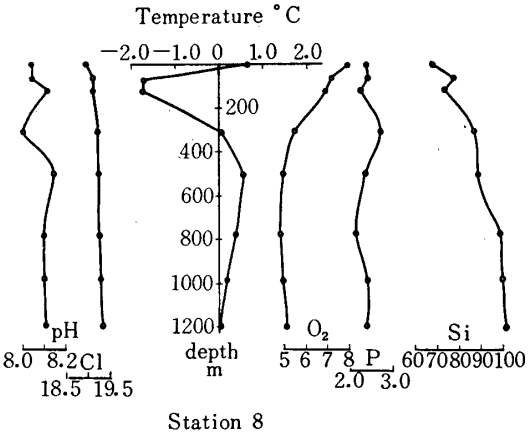


Fig. 10. Results of vertical observation.
16-II-1962 66°17.5′S, 33°30.5′E

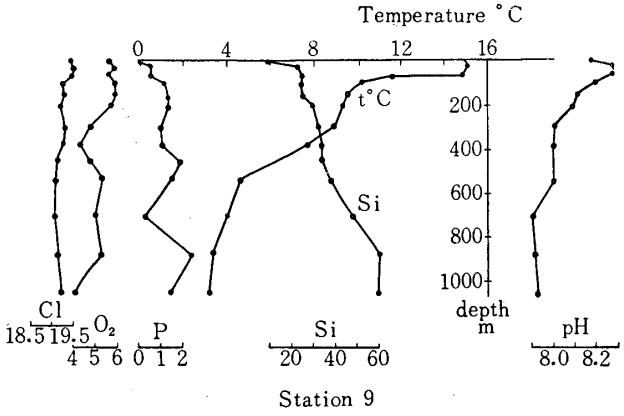


Fig. 11. Results of vertical observation.
24-II-1962 41°27′S, 21°07′E

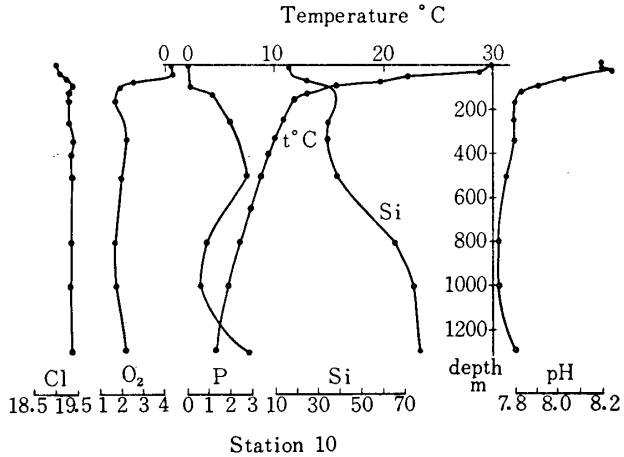


Fig. 12. Results of vertical observation.
22-III-1962 7°08.5′S, 76°48′E

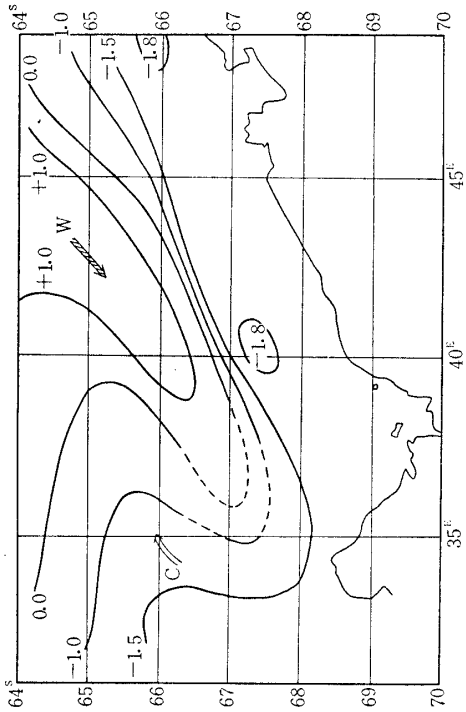


Fig. 15. Isotherm of 150 m depth.

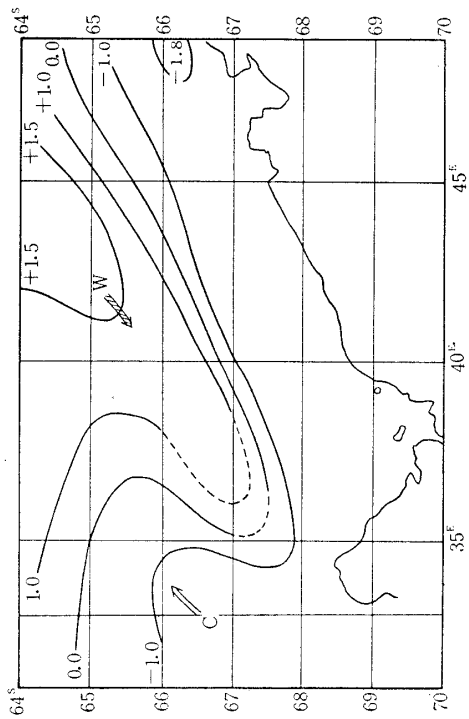


Fig. 16. Isotherm of 200 m depth.

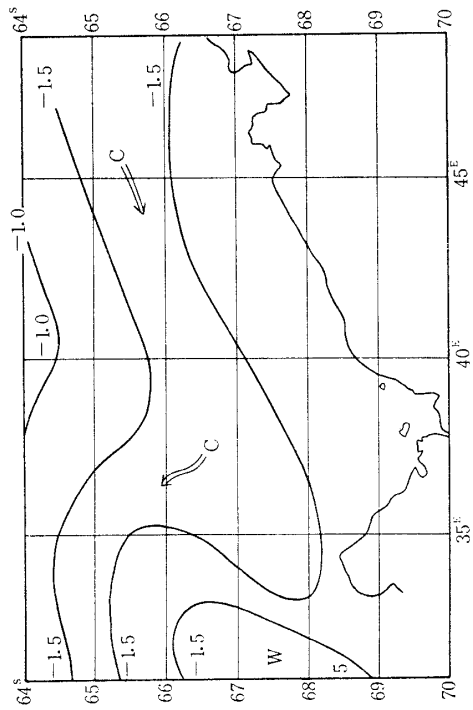


Fig. 13. Isotherm of 50 m depth.

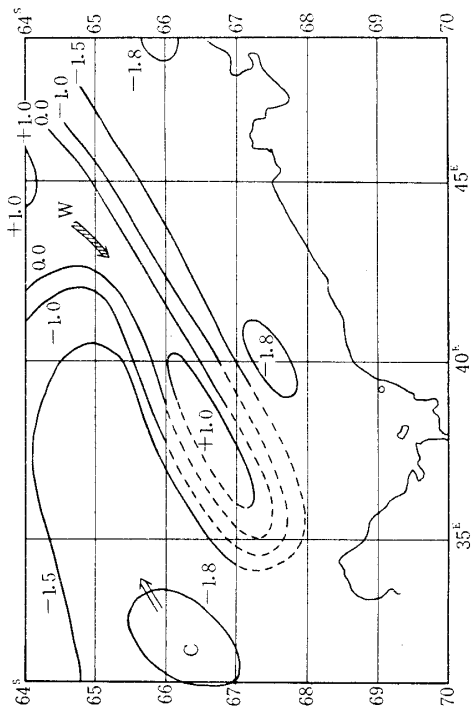


Fig. 14. Isotherm of 100 m depth.

(*Received Nov. 19, 1962*)

APPENDICES

1. Results of BT observation.

No.	1	2	3	4	5	6	7	8
day	2-11-1961	3-11-1961	4-11-1961	5-11-1961	6-11-1961	7-11-1961	8-11-1961	9-11-1961
time	1000	1005	0930	0930	0930	0930	0930	0930
location	28-11.5N 130-05E	25-33N 127-30E	22-34N 124-18E	19-28N 121-09E	16-32N 117-58E	13-35N 114-50E	10-25N 111-33E	07-32N 108-41E
00	25.2	26.8	26.2	27.0	27.6	28.0	28.5	28.0
10	25.1	26.6	26.0	27.0	27.6	28.0	28.5	28.0
20	25.1	26.6	26.0	27.0	27.5	28.0	28.5	27.9
30	25.0	26.6	26.0	27.0	27.5	25.1	28.5	27.4
50	24.9	26.5	26.0	27.0	27.3	20.5	28.5	24.0
75		26.3	26.0	24.5	23.0	19.3	25.6	23.2
100		24.9	23.5	22.2	21.3	18.5	21.5	22.7
125		23.2	22.4	21.3	18.9		17.7	
150		21.8	21.3	19.6	17.5		17.7	
175		21.0	21.1	18.5	16.5		16.5	
200				16.9	15.4		15.5	
225					14.4		14.5	
250					13.5		13.7	

No.	9	10	11	12	13	14	15	16
day	19-11-1961	20-11-1961	21-11-1961	22-11-1961	23-11-1961	24-11-1961	26-11-1961	27-11-1961
time	0930	0930	0930	0930	0930	0930	0930	0930
location	05-04N 93-31E	02-37N 90-17E	00-03N 86-32E	02-33S 83-05E	05-02S 79-26E	07-44S 75-42E	12-57S 69-00E	15-27S 65-17E
00	28.2	27.9	27.2	27.6	27.2	27.6	27.2	26.2
10	28.2	28.0	27.2	27.6	27.2	27.6	26.8	26.2
20	28.2	28.0	27.1	27.6	27.2	27.6	26.8	26.2
30	25.3	27.9	26.9	27.6	27.2	27.6	26.8	26.2
50	21.8	26.8	26.8	27.6	27.2	27.6	26.8	25.7
75	17.7	20.7	23.9	27.5	25.8	27.5	26.1	24.2
100	15.9	18.6	21.2	20.0	22.3	27.5	24.3	23.4
125	15.0	17.5	17.5	16.6	18.3	24.9	19.7	22.9
150	13.9	15.4	15.5	14.9	14.8	21.4	18.3	21.6
175	12.8	14.3	14.5	13.5	13.5	18.5	17.3	19.8
200		14.0	13.5	12.7	12.3	15.6	15.6	18.5
225		13.0		12.3	11.5	13.6	14.5	17.7
250				12.0	11.4	12.6	14.0	16.0

No.	17	18	19	20	21	22	23	24
day	28-11-1961	29-11-1961	30-11-1961	1-12-1961	2-12-1961	3-12-1961	4-12-1961	5-12-1961
time	0930	0930	0930	0930	0930	0930	0930	0930
location	18-04S 61-37E	20-34S 57-56E	22-30S 53-47E	24-20S 49-35E	26-20S 45-29E	27-51S 41-50E	29-49S 37-32E	31-40S 32-49E
00	26.0	25.6	26.3	25.0	24.2	23.8	21.0	20.7
10	26.0	25.6	26.3	25.0	23.8	23.8	21.0	20.6
20	25.9	25.6	26.3	25.0	23.5	23.8	20.9	20.6
30	25.9	25.5	25.7	24.8	22.8	23.8	20.8	20.5
50	25.9	24.6	24.3	24.5	22.0	22.2	20.5	20.3
75	24.3	18.8	23.5	24.1	19.8	20.3	19.2	19.7
100	24.1	17.9	23.1	23.3	18.3	19.2	18.6	18.8
125	23.8	17.1	22.5	23.0	17.8	17.8	17.8	18.2
150	22.7	21.3	22.0	22.5	17.3	17.1	17.5	17.8
175	21.1	20.7	21.3	22.0	16.3	16.5	17.1	17.3
200	20.6	19.8	20.3	21.3	15.4	16.0	16.8	17.3
225	19.9	19.0	19.5	20.6	14.8	15.4	16.6	17.3
250	18.6	18.1	18.7	19.2	14.2	15.1	16.3	17.2

No.	25	26	27	28	29	30	31	32
day	6-12-1961	15-12-1961	16-12-1961	17-12-1961	18-12-1961	19-12-1961	20-12-1961	21-12-1961
time	0930	0930	0930	0930	0930	0930	0930	0932
location	33-32 S	36-20 S	39-30 S	43-09 S	46-49 S	50-52 S	54-17 S	57-39 S
	28-32 E	19-22 E	21-50 E	25-15 E	27-44 E	30-55 E	33-34 E	37-02 E
00	22.8	18.1	20.6	11.6	6.6	2.4	1.4	1.2
10	22.8	18.1	20.6	11.4	6.3	2.4	1.4	1.2
20	22.8	18.2	20.6	11.0	6.2	2.4	1.4	1.2
30	22.8	18.1	20.5	10.8	5.8	2.4	1.4	1.2
50	22.7	14.9	20.1	10.4	5.5	2.4	1.4	1.2
75	19.8	13.9	19.4	10.3	5.4	1.8	1.4	0.5
100	18.8	13.3	18.9	9.8	5.3	1.6	1.0	0.3
125	18.0	12.8	18.5	9.2	5.0	1.7	0.5	0.3
150	17.4	12.2	18.1	9.5	4.8	1.0	0.5	−0.1
175	16.6	11.7	17.7	8.2	4.4	0.7	0.6	0.2
200	16.3	11.5	17.5	8.2	4.2	0.7	0.8	0.9
225	15.9	11.3	17.4	8.0	4.2	1.0	1.2	1.4
250	15.5	10.5	16.9	8.4	4.3	1.2	1.6	1.6

No.	33	34	35	36	37	38	39	40
day	21-12-1961	22-12-1961	23-12-1961	25-12-1961	27-12-1961	29-12-1961	30-12-1961	4-1-1962
time	0940	0930	0930	0830	0930	1630	0400	0100
location	57-40 S	61-04 S	64-32 S	65-43 S	66-18 S	65-00 S	65-43 S	65-26 S
	37-23 E	40-51 E	44-38 E	43-36 E	40-20 E	40-19.5 E	42-53.5 S	46-00 E
00	1.1	−0.2	−1.2	−1.7	−1.7	0.0	−0.9	−1.6
10	1.1	−0.2	−1.2	−1.7	−1.7	−0.2	−0.9	−1.7
20	1.0	−0.2	−1.3	−1.7	−1.7	−0.5	−1.2	−1.8
30	1.0	−0.2	−1.4	−1.8	−1.7	−0.5	−1.4	−1.8
50	0.9	−0.2	−1.5	−1.8	−1.7	−0.8	−1.7	−1.8
75	0.8	−0.4	−1.0	−1.8	−0.2	−1.5	−1.3	−1.8
100	0.5	−1.3	1.0	−1.1	1.1	−1.5	0.7	−1.7
125	0.5	−1.2	1.4	−0.2	1.3	−0.1	1.2	−1.6
150	0.4	−0.8	1.6	0.5	1.4	1.1	1.3	−0.9
175	0.7	0.0	1.6	0.8	1.5	1.3	1.4	−0.6
200	1.2	1.0	1.6	1.1	1.5	1.4	1.4	−0.8
225	1.4	1.1	1.6	1.2	1.5	1.5	1.4	−0.2
250	1.6	1.2	1.6			1.5	1.3	0.3

No.	41	42	43	44	45	46	47	48
day	4-1-1962	4-1-1962	7-1-1962	16-2-1962	17-2-1962	18-2-1962	21-2-1962	22-2-1962
time	1200	1330	1500	0500	0930	0930	0930	0930
location	65-49 S	65-48 S	67-09 S	66-18 S	63-33 S	60-27 S	52-21 S	48-37 S
	49-03 E	49-03 E	39-47 E	33-31 E	31-50 E	30-23 E	25-27 E	23-57 E
00	−1.5	−1.6	−1.5	−0.3	0.8	1.1	1.7	5.8
10	−1.5	−1.6	−1.8	−0.3	0.8	1.1	1.7	5.8
20	−1.6	−1.7	−1.8	−0.5	0.8	1.1	1.7	5.8
30	−1.7	−1.8	−1.8	−0.8	0.7	1.1	1.7	5.8
50	−1.8	−1.8	−1.8	−1.3	−1.6	1.0	1.7	5.8
75	−1.8	−1.8	−1.8	−1.5	−1.7	−0.8	1.1	5.7
100	−1.8	−1.8	−1.8	−1.5	−1.3	−0.7	0.4	4.5
125	−1.8	−1.5	−1.8	−1.5	0.2	−0.7	0.1	4.0
150	−1.8	−0.8	−1.8	−1.5	0.8	−0.4	0.2	3.7
175	−1.8	−0.2	−1.7	−1.5	1.1	0.5	0.5	3.3
200	−1.8	−0.3	−1.5	−1.3	1.3	1.2	1.1	3.5
225	−1.8	0.5	−1.0	−1.0	1.5	1.6	1.6	3.4
250	−1.8	0.7	−0.4		1.5	1.7	1.8	3.4

No.	49	50	51	52	53	54	55	56
day	23-2-1962	25-2-1962	9-3-1962	11-3-1962	12-3-1962	13-3-1962	14-3-1962	15-3-1962
time	0930	0930	0930	0930	0930	0930	0930	0930
location	44-46 S 22-38 E	37-04 S 19-31 E	32-33 S 30-12 E	29-36 S 38-04 E	27-13 S 42-05 E	26-06 S 45-42 E	24-38 S 48-44 E	22-54 S 52-22 E
00	11.3	22.2	24.6	25.3	27.1	27.1	27.7	27.5
10	11.3	22.2	24.5	25.4	27.1	27.1	27.7	27.5
20	11.3	22.2	24.2	25.4	26.8	27.1	27.7	27.5
30	11.3	22.2	24.0	25.3	26.4	27.0	27.7	27.5
50	11.3	21.9	23.7	25.3	26.3	24.5	26.4	27.5
75	10.4	18.7	20.5	22.3	25.7	23.5	25.5	24.5
100	9.9	16.1	19.3	21.0	23.0	22.0	24.2	22.6
125	9.8	14.2	18.3	18.7	21.7		23.0	21.2
150	9.6	12.8	18.2	17.1	19.4		21.7	20.2
175	9.7	11.7	17.7	11.8	18.3		20.4	19.0
200	9.5	10.7	17.5	11.3	17.3		19.0	17.7
225	9.5	10.2	17.4	10.9	16.7		18.2	17.0
250	9.4	9.6	17.0	10.6	16.0		17.5	16.3

No.	57	58	59	60	61	62	63	64
day	16-3-1962	17-3-1962	18-3-1962	19-3-1962	20-3-1962	21-3-1962	22-3-1962	23-3-1962
time	0940	0930	0930	0930	0930	0930	0930	0930
location	21-25 S 56-19 E	19-23 S 59-29 E	17-03 S 62-51 E	14-37 S 66-14 E	12-20 S 69-55 E	10-01 S 73-01 E	07-31 S 76-19 E	05-24 S 79-27 E
00	28.1	28.1	28.4	29.4	29.2	29.2	29.1	28.9
10	28.1	28.1	28.4	29.3	29.1	29.2	29.1	28.9
20	28.1	28.1	28.4	29.2	29.0	29.1	29.1	28.8
30	28.1	28.1	28.3	29.1	29.0	28.9	27.9	28.8
50	27.4	28.1	27.2	29.0	28.0	28.1	23.3	28.4
75	25.3	26.5	25.1	26.3	23.7	24.2	19.5	23.8
100	23.6	24.0	23.7	23.8	20.8	20.6	16.7	17.5
122	22.5	23.1	22.3	22.5	18.4	17.7	14.0	25.0
150	21.5	22.3	21.5	20.5	16.0	16.0	22.7	13.0
175	20.5	21.5	20.7	18.7	14.5	15.0	12.4	12.2
200	19.8	20.7	20.0	17.8	13.6	14.2	11.8	11.8
225	18.7	20.2	19.4	16.1	12.8	13.3	11.5	
250	17.8	18.8	18.4	15.6	12.2	12.7	11.1	

N0.	65	66	67	68	69	70	71	72
day	24-3-1962	25-3-1962	26-3-1962	7-4-1962	8-4-1962	9-4-1962	10-4-1962	11-4-1962
time	0930	0930	0930	0930	0930	0930	0930	0930
location	02-55 S 82-54 E	00-21 S 86-24 E	02-07 N 89-49 E	09-31 N 111-04 E	11-39 N 113-45 E	15-45 N 116-50 E	18-38 N 119-32 E	21-17 N 121-56 E
00	28.9	29.0	29.1	27.6	27.7	28.0	26.5	25.8
10	28.9	29.0	29.1	27.4	27.7	28.0	26.5	25.8
20	28.9	28.9	29.0	27.0	27.3	27.6	25.5	25.7
30	28.9	28.8	29.0	26.7	27.1	27.5	23.2	25.2
50	26.2	28.6	28.5	26.2	26.5	27.3	21.0	24.5
75	20.7	25.6	26.2	22.1	23.0	23.5	19.6	24.2
100	18.8	22.7	24.2	21.3	19.3	21.0	18.2	23.5
125	17.5	20.3	18.7	19.6	18.1	19.0	17.5	23.2
150	16.3	17.3	16.8	17.6	17.0	17.3	16.3	22.3
175	15.7	14.5	14.7	16.7	16.3	16.3	14.7	21.4
200	15.0	13.5	12.8	14.7	15.7	15.6	13.1	20.6
225	14.4	12.4	12.4	13.5	14.9	14.6	12.5	19.5
250		12.0	12.2	13.2	14.2	13.9	12.2	17.8

No.	73	74						
day	12-4-1962	13-4-1962						
time	0930	0930						
location	23-39 N 125-17 E	26-43 N 128-36 E						
00	22.8	22.0						
10	22.7	22.0						
20	22.7	21.8						
30	22.5	21.6						
50	22.2	21.4						
75	21.5	21.0						
100	20.8	20.8						
125	20.2	20.4						
150	19.4	20.2						
175	18.7	19.5						
200	18.3	19.0						
225	17.7	18.5						
250	17.3	—						

2. Details of vertical observations.

Station	Date	Locality	Observation depth	Dredge
1	36-XII-27 1000-1330	66-18 S 40-20 E	1000 m	
2	36-XII-29 1650-1800	65-00 40-19.5	2500	
3	36-XII-30 0400-0730	65-43 42-53.5	2500	
4	37-I-3～4 2310-0300	65-26 46-00	2500	
5	37-I-4 1200-1700	65-48.8 49-02.8	2500	Angle 10° depth 2560m stone 100, max. 9 cm×7 cm×3 cm mud 0.4*l*, shells.
6	37-II-15 2300-2400	67-33 33-35	1000	Angle 40° depth 980m mud 1.1*l*, shells stone 200, max. 7 cm×3.5 cm×3 cm
7	37-II-16 0345-0500	66-58 33-33	BT only	Angle 10° depth 1210m stone 16, max. 3 cm×2 cm×2 cm mud 0.12*l*.
8	37-II-16 0930-1040	66-17.5 33-30.5	1200	Angle 20° depth 1260m stone 2, mud 2.0*l*
9	37-II-24 0630-1010	41-27 21-07	1200	
10	37-III-22 1300-1600	07-08.5 76-48	1500	

3. Subsurface oceanographic observation.

Station 1. Dec. 27, 1961 1000~1330 66°18′S 40°20′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−1.6	ice						
10	−1.82	7.98	7.14	3.6	50	18.87	0.2	n. d.
25	−1.81	8.02	7.15	3.7	51	18.87	0.1	
50	−1.84	8.10	6.72	2.7	42	18.92	0.2	
75	−1.47	7.92	6.45	2.7	69	19.03	0.3	
85	1.97	7.94	4.40	4.8	73	19.16	—	
122	0.19	7.96	4.20	3.6	82	19.19	—	
161	1.31	8.10	3.96	4.1	91	19.22	—	
242	1.37	8.00	4.25	4.0	73	19.22	—	
327	1.37	8.00	4.18	3.9	86	19.23	0.1	
418	1.29	7.90	4.38	3.7	68	19.23	—	
610	1.07	7.93	4.18	4.2	87	19.22	Tr	
809	0.89	7.90	4.46	3.0	87	19.22	—	
1009	0.71	7.92	4.40	2.5	96	19.21	Tr	

Station 2. Dec. 29, 1961 1630~1800 65°00′S 40°19.5′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−0.2	7.90	7.72	3.3	21	18.82	n. d.	n. d.
10	−0.20	8.00	7.62	2.3	21	18.87		
25	−0.59	7.98	7.63	2.2	21	18.86		
50	−1.03	7.98	7.83	2.8	21	18.88		
75	−1.71	8.06	7.41	3.2	60	18.92		
100	−1.62	7.90	7.15	1.8	60	18.97		
144	0.56	7.82	4.93	3.1	69	19.11		
192	1.21	7.90	4.49	1.2	78	19.18		
292	1.42	7.92	4.30	1.8	87	19.20		
392	1.42	7.91	4.28	2.2	78	19.21		
492	1.31	7.95	4.36	2.7	87	19.20		
597	1.21	7.90	4.31	3.4	106	19.22		
791	1.00	7.90	4.81	4.1	87	19.21		
985	0.82	7.89	4.47	2.8	101	19.20		
1201	0.64	8.00	4.49	1.1	87	19.20		
1498	0.47	8.00	4.57	3.3	97	19.20		
1992	0.26	7.92	4.76	4.2	111	19.19		
2489	0.07	8.01	4.84	2.5	120	19.20		

Station 3. Dec. 30, 1961 0400～0730 65°-43′S 42°53.5′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−1.0	7.90	7.59	4.1	56	18.76	n. d.	n. d.
9	−0.76	7.96	7.68	3.7	58	18.85		
24	−1.15	7.98	7.61	3.6	58	18.84		
46	−1.85	7.93	7.00	3.2	56	19.23		
69	−1.81	7.99	6.67	3.3	65	19.13		
92	0.32	7.90	4.98	3.7	78	19.14		
140	1.18	7.83	4.26	2.2	68	19.22		
189	1.34	7.91	4.36	1.9	68	19.20		
288	1.20	7.85	4.39	4.1	87	19.19		
389	1.13	7.89	4.50	3.7	87	19.20		
487	1.00	7.98	4.33	4.1	86	19.23		
621	0.90	7.98	4.40	3.4	78	19.16		
816	0.79	7.88	4.56	4.2	77	19.22		
1010	0.63	7.98	4.66	2.7	111	19.22		
1204	0.43	7.92	4.49	4.0	97	19.21		
1498	0.31	7.92	4.71	0.2	97	19.19		
1993	0.05	7.92	5.02	2.1	97			
2491	−0.16	7.89	5.09	2.3	92			

Station 4. 3～4, Jan. 1962 2310～0300 65°26′S 46°00′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−1.6	7.93	7.55	2.3	60	18.69	n. d.	n. d.
9	−1.54	8.00	7.29	2.5	69	18.74		
23	−1.79	7.97	6.88	2.8	69	18.88		
46	−1.81	8.08	6.81	2.7	87	18.93		
69	−1.80	8.00	6.82	2.4	81	19.01		
92	−1.77	8.00	6.85	2.8	69	19.01		
136	−1.18	8.10	6.35	2.4	87	19.15		
178	−0.65	8.00	6.25	2.8	78	19.26		
259	0.62	8.00	5.01	2.8	86	19.30		
348	0.92	8.02	4.77	2.4	97	19.31		
440	0.78	7.98	4.95	2.0	97	19.37		
505	0.76	7.92	4.59	2.8	99	19.37		
738	0.70	8.00	4.69	2.9	106	19.19		
912	0.52	8.00	4.75	3.2	106	19.18		
1085	0.43	8.00	4.73	2.1	115	19.36		
1350	0.24	7.90	4.95	2.9	115	19.19		
1820	0.00	7.93	4.97	2.9	114	19.19		
2307	−0.19	7.99	5.18	2.8	87	19.18		

Station 5. Jan. 1962 1200~1740 45°48.8′S 46°00′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−1.2	7.98	7.94	0.3	53	18.77	n. d.	n. d.
10	−1.27	8.18	7.78	2.1	43	18.76		
25	−1.44	8.18	7.81	2.4	43	18.78		
50	−1.82	8.11	7.02	2.4	62	18.90		
75	−1.84	8.17	7.05	2.4	62	18.96		
100	−1.83	8.12	7.09	2.4	66	18.97		
149	−1.81	7.92	7.29	2.4	51	19.00		
195	−1.82	8.00	7.22	2.4	51	19.02		
290	−1.72	7.92	7.29	2.4	66	19.13		
390	−1.18	8.03	6.71	2.0	53	19.19		
514	0.39	7.90	5.13	1.9	79	19.16		
612	0.49	7.87	4.80	2.4	72	19.20		
809	0.34	7.88	4.85	2.4	87	19.22		
1006	0.13	7.86	5.01	2.4	97	19.20		
1203	−0.02	7.89	4.91	2.4	97	19.19		
1502	−0.08	7.88	5.09	2.4	83	19.18		
2002	−0.20	7.90	5.25	2.4	97	19.21		
2502	−0.23	8.01	5.16	2.4	106	19.21		

Station 6. Feb. 15, 1962 2300~2400 67°33′S 33°35′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	−1.6	7.95	7.19	2.7	65	18.85	Tr	—
45	−1.82	8.10	7.09	2.4	56	18.93	0.4	Tr
90	−1.80	8.15	6.81	2.1	61	19.04	0.2	2.1
243	−0.77	8.01	6.27	2.1	69	19.17	0.4	5.6
404	−0.47	8.07	5.26	2.8	83	19.22	0.7	—
674	0.17	8.10	4.97	2.3	85	19.26	Tr	8.0
870	−0.15	7.98	4.92	2.4	97	19.23	0.3	5.0

Station 8. Feb. 16, 1962 0930~1040 66°17.5′S 33°30.5′E

depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	0.7	8.05	7.90	2.3	61	18.89	±	—
89	−1.79	8.06	7.09	2.4	69	19.10	0.1	10.0
134	−1.78	8.12	6.96	2.2	65	19.11	0.6	—
315	0.06	8.00	5.43	2.7	79	19.23	0.2	0.5
500	0.55	8.15	4.99	2.3	79	19.24	6.7	±
787	0.37	8.10	4.87	2.1	87	19.28	7.5	Tr
981	0.20	8.10	4.98	2.4	92	19.29	Tr	10.4
1180	0.03	8.10	5.13	2.4	97	19.24	±	10.8

Station 9. Feb. 24, 1962 0630~1010 41°27′S 21°07′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl ‰	NO_2 μg A/L	NO_3 μg A/L
00	15.0	8.18	5.70	—	—	19.41	—	—
10	15.05	8.28	5.90	0.6	13	19.47	0.1	0.7
24	14.99	8.28	5.85	0.5	13	19.49	0.1	0.1
47	14.86	8.20	5.55	0.5	17	19.49	0.1	Tr
71	11.61	—	—	—	—	—	—	—
95	10.83	8.20	5.81	1.2	17	19.25	0.3	4.0
143	9.79	8.12	5.74	1.3	17	19.24	0.3	1.8
192	9.25	8.10	5.63	1.3	22	19.18	0.7	7.2
289	8.92	8.02	4.78	1.0	24	19.27	2.8	8.6
389	7.82	8.00	4.28	1.0	26	19.21	6.0	10.0
446	6.34	8.00	4.71	1.9	26	19.14	0.9	15.0
533	4.80	8.00	5.29	1.5	30	19.06	1.7	17.0
700	4.09	7.90	5.01	0.2	40	19.06	0.1	Tr
875	3.44	7.92	5.16	2.4	52	19.10	5.0	5.6
1056	3.22	7.92	4.00	1.5	52	19.17	1.3	15.4

Station 10. Mar. 22, 1962 1300~1600 7°08.5′S 76°-48′E

Depth m	t°C	pH	O_2 ml/L	P μg A/L	Si μg A/L	Cl μg A/L	NO_2 μg A/L	NO_3 μg A/L
00	30.0	8.20	4.28	—	9	18.97	—	—
9	28.79	8.20	4.29	—	9	19.12	—	—
22	28.48	8.25	4.43	0.2	9	19.27	—	—
44	22.53	—	—	—	—	—	—	—
66	19.07	8.02	2.56	0.3	17	19.37	0.1	0.2
87	15.86	79.0	2.00	0.2	26	19.29	0.1	±
122	12.86	7.82	1.74	1.3	30	19.29	1.0	3.0
159	11.90	7.80	1.75	1.3	30	19.32	0.7	4.4
237	11.08	7.80	2.10	2.0	26	19.38	1.0	—
320	10.21	7.80	2.25	2.3	26	19.35	1.0	5.2
400	9.55	—	—	—	—	—	—	—
485	8.76	7.75	2.04	2.7	30	19.34	1.4	—
805	6.70	7.72	1.67	0.9	56	19.32	3.0	10.2
1000	5.72	7.72	1.70	0.6	65	19.31	—	8.2
1300	4.56	7.80	2.07	2.9	68	19.31	—	8.2

4. Oceanographical data observed by the observation ship, the SOYA between Cape Town and Lützow-Holm Bay.

Date	Time (SAT)	Locality	Water temp. °C	pH	Dissolved O_2 *ml*/L	Phosphate-P μg atoms/L	Silicate-Si μg atoms/L	Nitrite-N μg atoms/L	Nitrate-N μg atoms/L	Chlorinity ‰	Weather	Atmospher. temp. °C	Wind m/sec	Wave	Swell
Dec.14		S E													
15	0930	36-20 19-22	17.9	8.13	n. d.	1.3	13	—	Trace	19.68	①	17.8	E 9.9	E 6.0 2¼	E 8.5 4¼ S 9.7 2½
16	0930	39-30 21-50	20.3	8.17	4.91	Tr	0	—	±	19.76	①	18.0	ENE 8.4	ENE 3.0 1.0	NNE 9.8 2¼ S 9.2 2.0 E 5.5 1¾
17	0930	43-09 25-15	12.7	8.10	6.08	0.9	0	+	++	19.09	≡	11.5	N 8.3	N 3.0 ½	W 12.2 3.0 N 6.2 1¾ S SW10.0 1¼
18	0930	46-49 27-44	6.2	8.07	6.97	1.8	7	0.4	+	18.74	≡	9.2	N 16.2	N 5.0 2.0	WNW12.5 4.0 SW 12.0 3.0 N 8.0 2½
19	0930	50-52 30-55	2.2	8.07	7.54	2.3	22	0.3	++	18.74	①	2.9	NW 12.6	NW 5.0 1¾	WNW14.5 4½ N 9.5 2¼
20	0930	54-17 33-34	1.5	8.02	7.54	3.6	30	Tr	+	18.84	◎	0.4	W 11.4	WSW 6.0 2¾	WSW14.0 5½ W 12.5 4.0
21	0930	57-39 37-02	0.8	8.02	7.93	2.7	30	0.3	++	18.86	⊜	0.3	WSW 11.4	W 4.8 2½	W 13.0 5.0 WSW 7.2 4¾ SW 14.0 3¾
22	0930	61-04 40-51	−0.7	8.03	8.30	2.6	51	0.3	++	18.83	⊜	−0.8	WNW 9.0	W 4.5 1.0	WNW11.5 3¾ S SW12.0 2.0 W 7.2 1½
23	0930	64-32 44-38	−1.5	8.01	7.56	1.2	50	0.2	+	18.77	⊜	−1.1	WNW 7.1	WNW 3.5 ¾	WNW12.0 3.0 W 11.2 2¼
24	0930	65-28 44-53	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	◎	−1.3	ENE 5.6	ice	
25	0930	65-43 43-36	−1.8	7.90	7.41	2.2	51	0.1	++	18.77	⊁	−1.7	ESE 13.6	E 3.0 ¼	NNE 9.5 3½ NE 6.0 1¾
26	0930	66-30 40-38	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	⊗	−1.1	E 9.8	E 1.0 ¼	ice.
27	1000-13-30	66-18 40-20	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	n. d.	①	−1.3	ESE 3.5	ice	
29	1630	65-00 40-19.5	−0.3	7.90	7.72	3.3	51	0.1	+	18.82	⊗	−0.5	N 3.2	N 2.0 ¼	NW 12.5 2.0 NNE 7.5 1.0
30	0400	65-43 42-53.5	−1.0	7.90	7.59	4.1	56	0.3	+	18.76	⊜	−5.0	E 5.3	E 2.0 ¼	NNW12.3 1½ NNE 9.0 1.0
Jan. 3	2300	65-26 46-00	−1.6	7.93	7.55	2.3	60	n. d.	n. d.	18.69	⊗	−1.6	NE 4.7	NE 2.0 1¼	E 8.2 1¾ WNW10.2 1½
4	1130	65-48.8 49-02.8	−1.2	7.98	7.94	0.3	53	n. d.	n. d.	18.77	◎	−1.7	WNW 3.5	NNW 2.5 ¼	NNE13.0 1¾ WNW 9.8 1½

n. d.: not determined —: none

5. Oceanographical data observed by the observation ship, the SOYA between Lützow-Holm Bay and Cape Town.

Date	Time (SAT)	Locality	Water temp. °C	pH	Dissolved O_2 *ml*/L	Phosphate-P μg atoms/L	Silicate-Si μg atoms/L	Nitrite-N μg atoms/L	Nitrate-N μg atoms/L	Chlorinity ‰	Weather	Atmospher. temp. °C	Wind m/sec	Wave	Swell
Feb.		S E													
15	2100-2400	67-33 33-35	−1.6	7.95	7.19	2.8	64	Tr	—	18.85	◎	−6.4	ESE 7.4	E 3.0 1/4	NNW10.5 3/4 WNW 8.0 1/2
16	0400-0500	66-58 33-33	−0.2	8.10	8.43	2.4	60	Tr	—	18.98	⊗	−1.7	E 6.0	ESE 3.0 1/2	NNW11.0 1.0 ENE 6.0 1/2
16	0930-1200	66-17.5 33-30.5	+0.7	8.05	7.91	2.3	60	Tr	—	18.89	⊗	−0.7	ENE 5.6	E 2.0 1/2	WNW 9.7 1.0 NNW 8.8 3/4 E ~9 3/4
17	0930	63-33 31-50	1.0	8.00	n. d.	0.6	44	—	Tr	18.64	⚹ ▽	0.3	SSW 14.9	SSW 5.5 2 1/2	WNW 9.5 4.0 NNW 8.5 3 1/2
17	0930	60-27 30-23	1.0	7.98	n. d.	1.3	50	—	±	18.66	◎	1.1	WNW 15.2	WNW 5.2 2 1/2	NNW11.0 4 1/2 WNW 8.0 4.0 SSW10.2 2.0
18	0930	57-59 29-05.5	2.2	7.95	n. d.	0.6	34	—	—	18.77	●	2.5	NW 16.7	NW 7.0 4.0	WNW11.2 6 1/2
20	0930	55-23 27-17	2.1	7.93	n. d.	0.2	24	—	—	18.82	⚹	3.1	WNW 20.6	WNW 5.5 3 1/2	W 14.2 6 1/2 NW 11.5 4 1/2
21	0930	52-21 25-57	2.0	7.93	n. d.	—	24	—	—	18.85	◑	1.6	W 16.2	W 4.7 3.0	W 13.0 6 1/2 NW 11.2 5.0
22	0930	48-37 23-57	5.6	8.02	n. d.	—	17	—	—	18.70	◑	4.0	SW 13.3	SW 5.5 2 1/2	W 13.5 4 1/2 SW 12.0 4.0 WNW11.5 2 1/2
23	0930	44-46 22-38	11.0	8.10	6.10	—	8	—	—	19.14	◎	9.9	NNW 6.5	NNW 2.5 1/2	SSW10.0 2 1/4 SW 12.5 2.0 W 9.0 1 1/2
24	0630-0930	41-27 21-07	15.0	8.18	5.70	—	0	—	—	19.41	◎	15.0	S 4.8	S 1.0 1/4≧	ENE10.5 3 1/4 E 7.8 1 3/4
25	0930	37-04 19-31	21.0	8.20	4.95	Tr	17	—	—	19.58	◎	18.4	SSE 7.1	SSE 4.0 1.0	SSW 9.0 2.0 SE 8.5 1 1/2